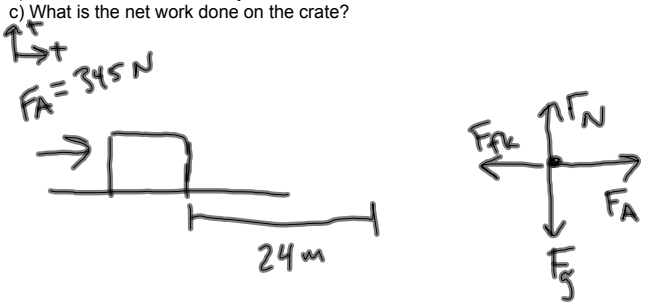
HW: Worksheet

A worker pushes a 1500 N crate with a horizontal force of 345 N a distance of 24.0 m. Assume the coefficient of kinetic friction between the crate and the floor is 0.220.
a) How much work is done by the worker on the crate?
b) How much work is done by the floor on the crate?
c) What is the net work done on the crate?



a) $\rightarrow F_A$, $\rightarrow d$, $\theta_1 = 0°$

$$W_A = F_A d \cos\theta_1$$
$$= (345\ N)(24\ m)\cos(0°)^1$$
$$= 8280\ J$$

b) $\leftarrow F_{fk}$, $\rightarrow d$, $\theta_2 = 180°$

$$W_f = F_{fk} d \cos\theta_2$$
$$= (330\ N)(24\ m)\cos(180°)^{-1}$$
$$= -7920\ J$$

find F_{fk}:

$$F_{fk} = \mu_k F_N$$
$$= (.22)(1500\ N)$$
$$= 330\ N$$

$$\Sigma F_y = 0$$
$$F_N - F_g = 0$$
$$F_N = F_g$$

c) $W_{net} = W_A + W_f$
$= 360\ J$

Types of Energy: [Brainstorm]

Kinetic
Chemical
Potential
Thermal
Electrical
Radioactive
Electromagnetic
Nuclear

Types and Examples:

1. Mechanical
   - Kinetic → moving roller coaster
   - Gravitational Potential → drop tower
   - Spring → stretching or compressing
2. Chemical → battery
3. Nuclear → core of stars
4. Electromagnetic
   - Electric
   - Magnetic
5. Thermal → HVAC system

Mechanical Energy:

- Kinetic Energy
  - Energy of motion
  - Equation: $K = \frac{1}{2}mv^2$
    - K: kinetic energy
    - m: mass
    - v: velocity
  - Sometimes we care about the change in kinetic energy:

$$\Delta K = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

- Gravitational Potential Energy:
  - Energy associated with being at a different height than your zero point
  - Equation: $U_g = mgh$
    - U_g: grav. potential energy
    - m: mass
    - g: accel. due to gravity
    - h: height
  - Sometimes care about change in U_g:

$$\Delta U_g = mgh_f - mgh_i$$

- Total Energy:

$$E_{total} = \Delta K + \Delta U_g$$

- Relationship between Work and Energy:
  - Work-Energy theorem:

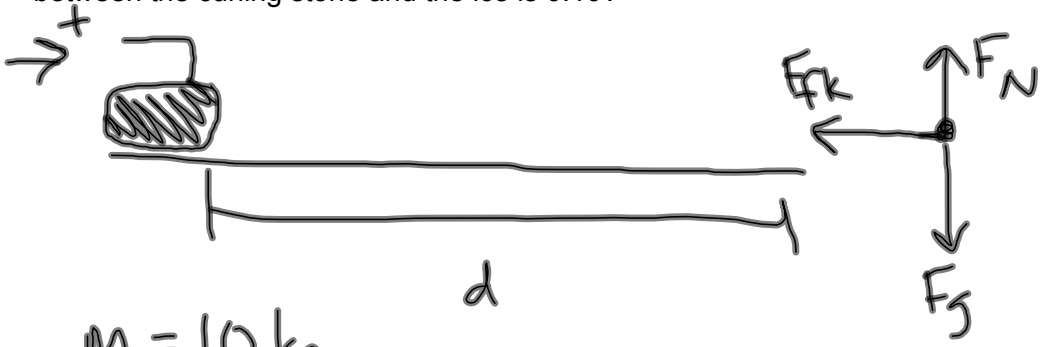
amount of work done on an object equals its change in total energy

$$W = \Delta E$$

$$\boxed{W = \Delta K + \Delta U_g}$$

$$F d \cos\theta = \frac{1}{2} m (v_f^2 - v_i^2) + m a_g (h_f - h_i)$$

On a frozen pond, a person slides a 10.0 kg curling stone, giving it an initial speed of 2.2 m/s. How far does the curling stone move if the coefficient of kinetic friction between the curling stone and the ice is 0.10?



$m = 10\ kg$

$v_i = 2.2\ m/s$

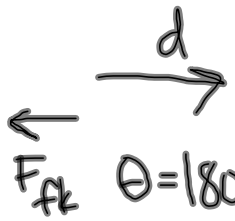
$\mu_k = 0.10$

$v_f = 0\ m/s$

$$W_f = \Delta K + \Delta U_g \quad (\Delta U_g = 0)$$

$$F_{fk}\, d \cos\theta = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \quad (\tfrac{1}{2}mv_f^2 = 0)$$

$$F_{fk}\, d \cos\theta = -\frac{1}{2}mv_i^2 \quad (\cos\theta = -1)$$



$$d = \frac{-\frac{1}{2}mv_i^2}{F_{fk}(-1)}$$

find F_{fk}:

$$= \frac{(10\ kg)(2.2\ m/s)^2}{2(9.8\ N)}$$

$$F_{fk} = \mu_k F_N$$

$$= (.10)(10\ kg)(9.8\ m/s^2)$$

$$= 2.47\ m$$

$$= 9.8\ N$$